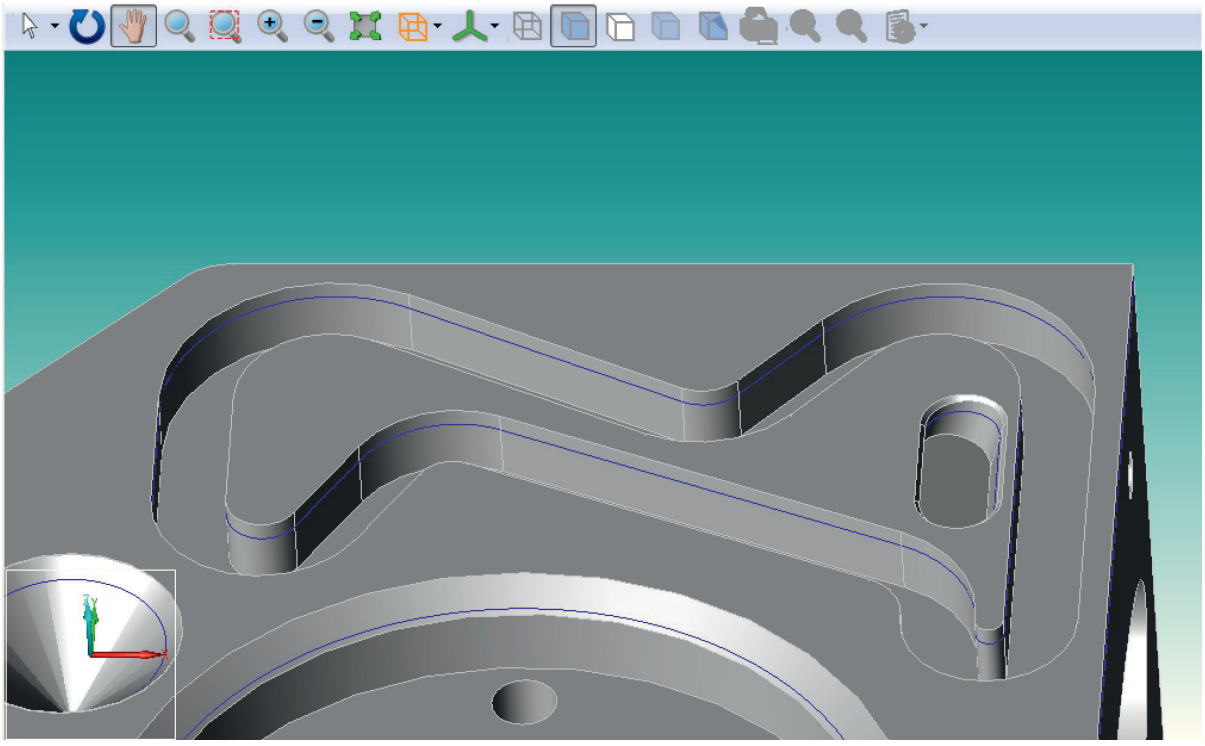
Tutorial
H-1000-5308-01-A

RENISHAW
apply innovation™

Curve scanning considering all 5-axis benefits / influences (CAD)



© 2013 Renishaw plc. All rights reserved.

Renishaw® is a registered trademark of Renishaw plc.

This document may not be copied or reproduced in whole or in part, or transferred to any other media or language, by any means, without the prior written permission of Renishaw.

The publication of material within this document does not imply freedom from the patent rights of Renishaw plc.

Disclaimer

Considerable effort has been made to ensure that the contents of this document are free from inaccuracies and omissions. However, Renishaw makes no warranties with respect to the contents of this document and specifically disclaims any implied warranties. Renishaw reserves the right to make changes to this document and to the product described herein without obligation to notify any person of such changes.

Trademarks

All brand names and product names used in this document are trade names, service marks, trademarks, or registered trademarks of their respective owners.

Renishaw part no: H-1000-5308-01-A

Issued: 12 2013

Curve scanning considering all 5-axis benefits / influences (CAD)

Care of equipment

Renishaw probes and associated systems are precision tools used for obtaining precise measurements and must therefore be treated with care.

Changes to Renishaw products

Renishaw reserves the right to improve, change or modify its hardware or software without incurring any obligations to make changes to Renishaw equipment previously sold.

Warranty

Renishaw plc warrants its equipment for a limited period (as set out in our Standard Terms and Conditions of Sale) provided that it is installed exactly as defined in associated Renishaw documentation.

Prior consent must be obtained from Renishaw if non-Renishaw equipment (e.g. interfaces and/or cabling) is to be used or substituted. Failure to comply with this will invalidate the Renishaw warranty.

Claims under warranty must be made from authorised service centres only, which may be advised by the supplier or distributor.

Trademarks

Windows 98, Windows XP, Windows 2000 and Windows NT are registered tradenames of the Microsoft Corporation.

IBM is the tradename of the International Business Machines Inc

All trademarks and tradenames are acknowledged.

Contents

1 Curve scanning considering all 5-axis benefits / influences (CAD) 6

1.1 Tutorial pre-requisites 6

1.2 Tutorial objectives 6

2 Introduction 7

3 Create a slice through the CAD model 8

4 Create a multi curve on the model 12

5 Scan the multi curve 18

6 Tolerance and output the measured data 22

1 Curve scanning considering all 5-axis benefits / influences (CAD)

1.1 Tutorial pre-requisites

- The student should have completed:
  - ‘Introduction to 5-axis measurement and movement techniques’
  - ‘Bore / boss scanning using all 5-axis techniques’
  - ‘Plane scanning’
  - ‘Further feature measurement and output (CAD)’

1.2 Tutorial objectives

- To provide further exposure to various methods of feature measurement and scan path definition using the REVO system
- To further develop CAD manipulation techniques to facilitate scan path definition
- Further exposure to program optimisation through the use of multiple scans in a single feature and probe path manipulation
- Further exposure to feature measurement and output

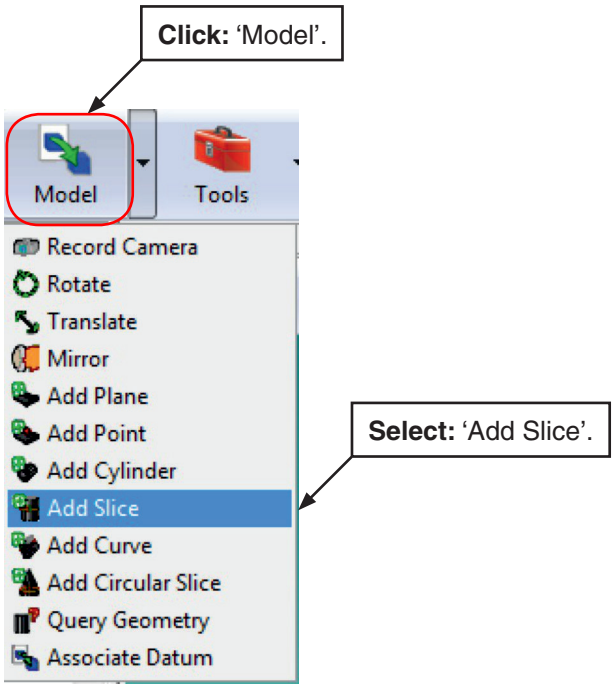
2 Introduction

This tutorial expands on the techniques described in earlier scanning tutorials. Additionally, it further reinforces the use of tolerance definition, output and the use of scan path manipulation when scanning with the REVO system.

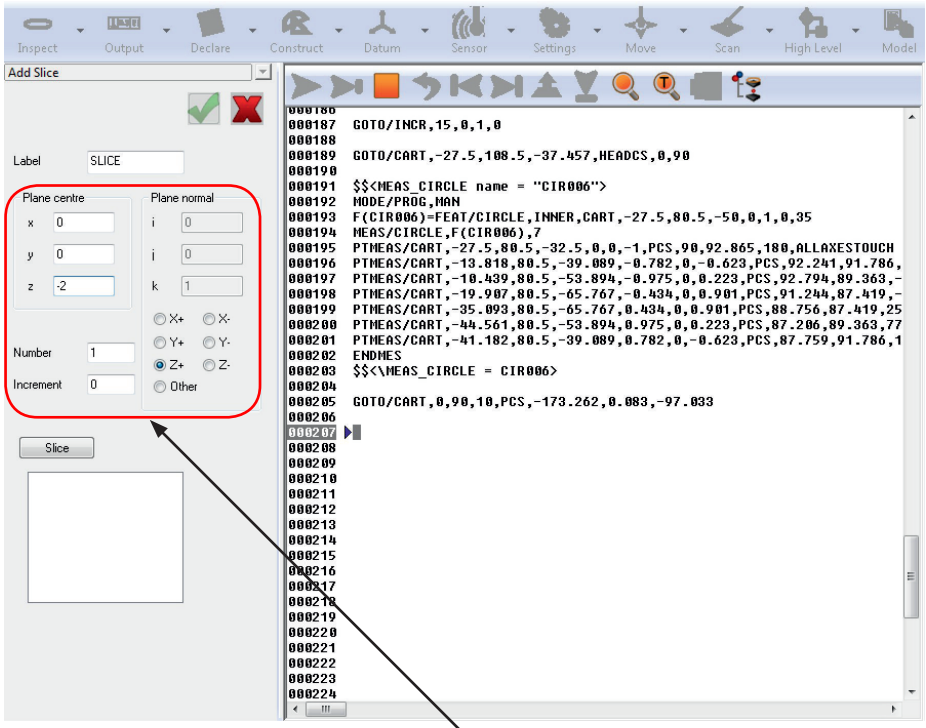
3 Create a slice through the CAD model

Before commencing this tutorial the component should be precisely aligned as previously described.

Before scanning a curve a slice needs to be created through the component to enable creation of the scan path.

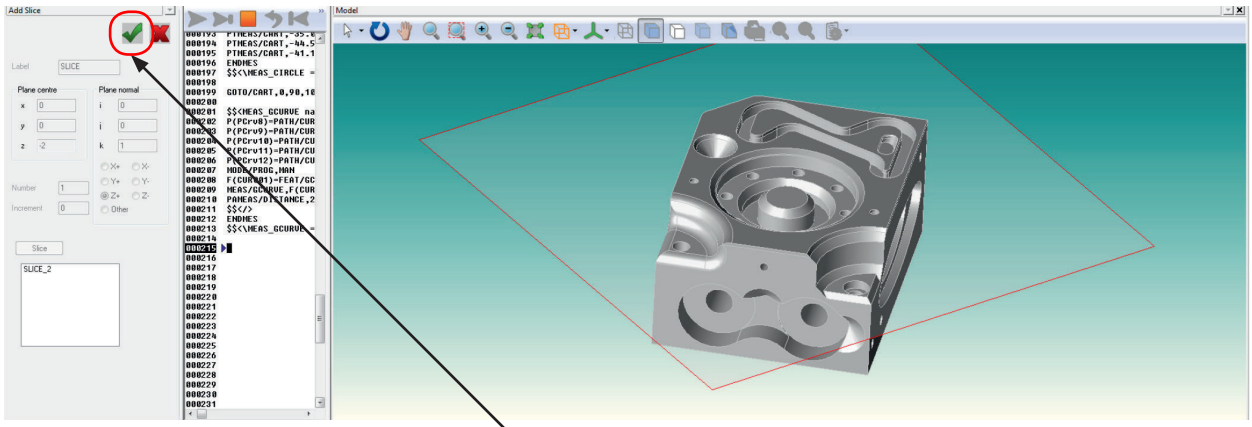


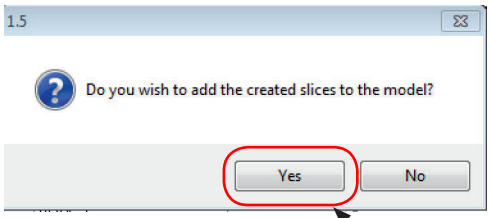
In this tutorial, a slice offset slightly below the top face will be created.

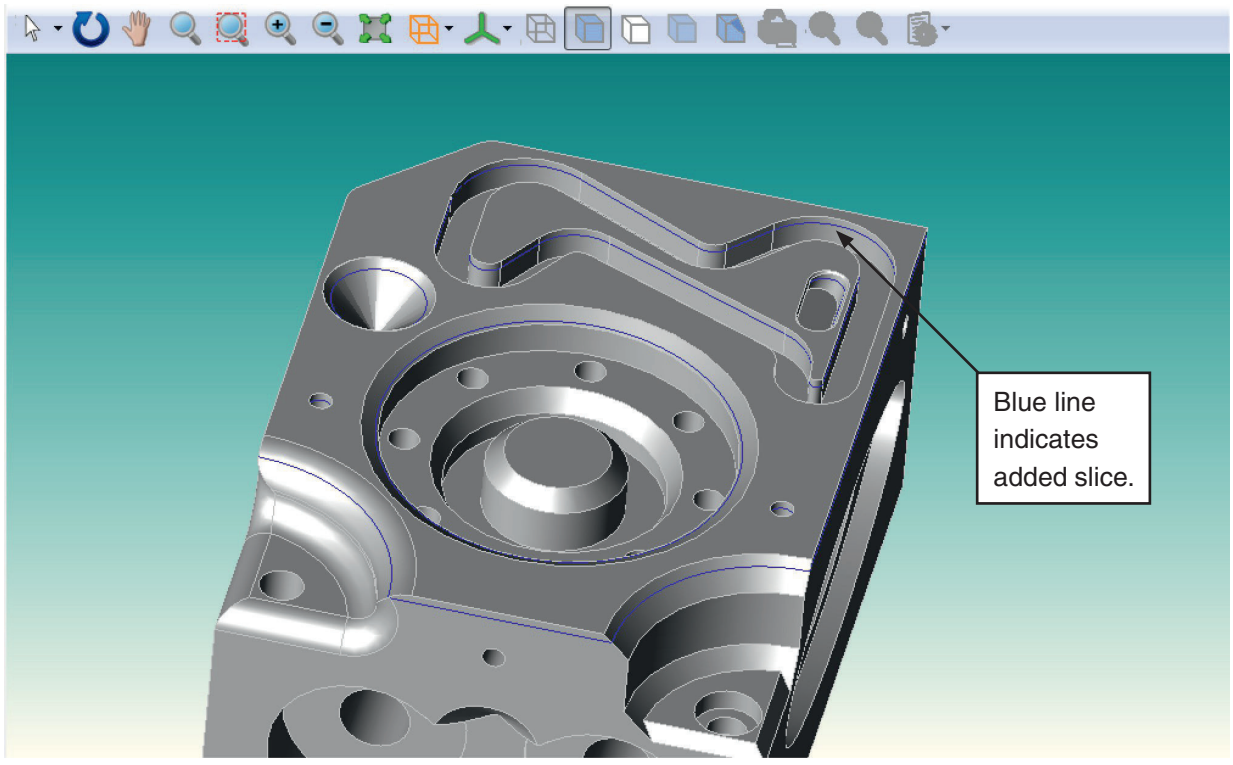


At the screen shown above, define the ‘Plane Centre’, the ‘Plane Normal’, the ‘Number’ of slices required and the ‘Increment’ between them.

When the required information has been entered click on the ‘Slice’ button

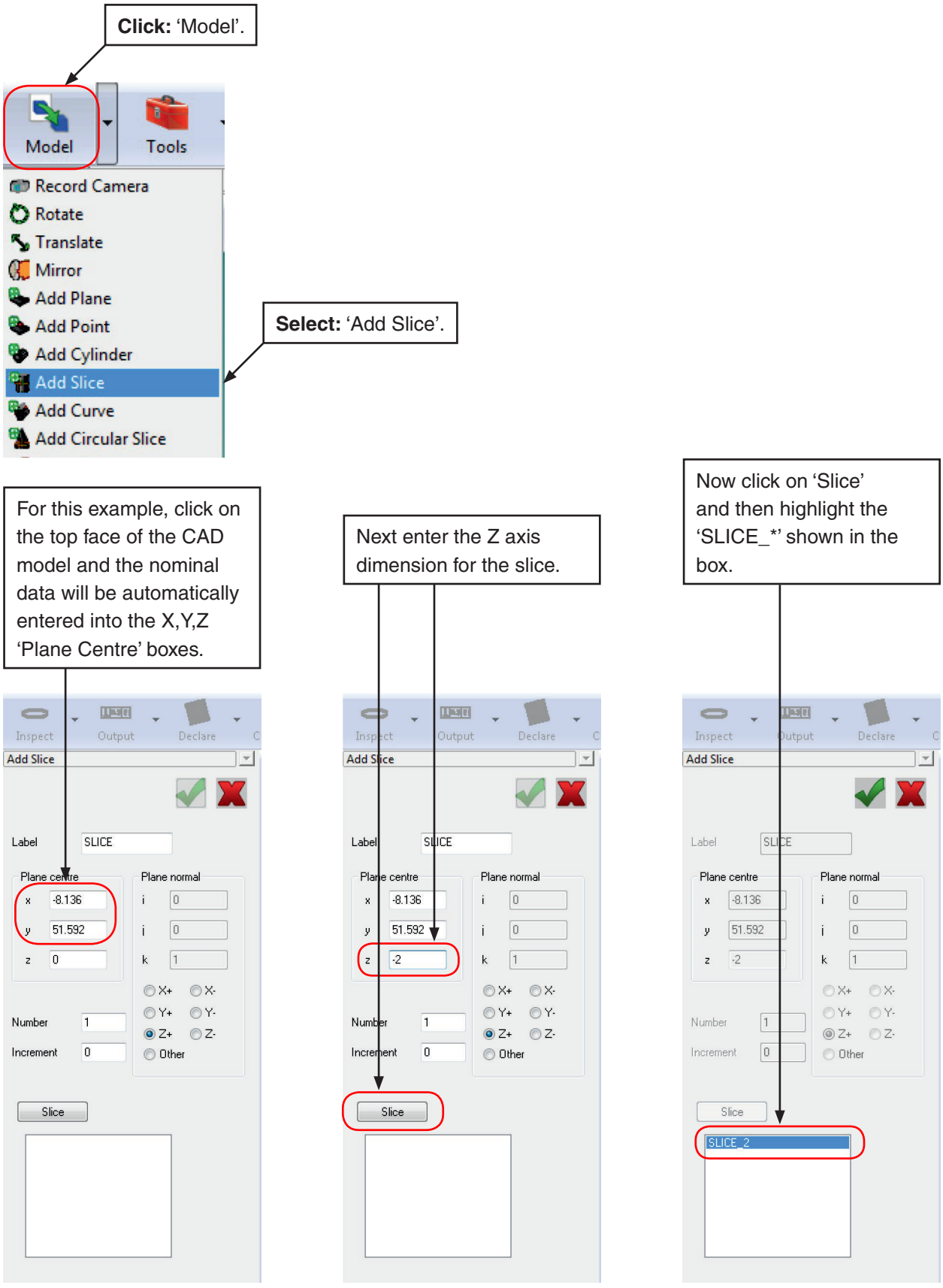


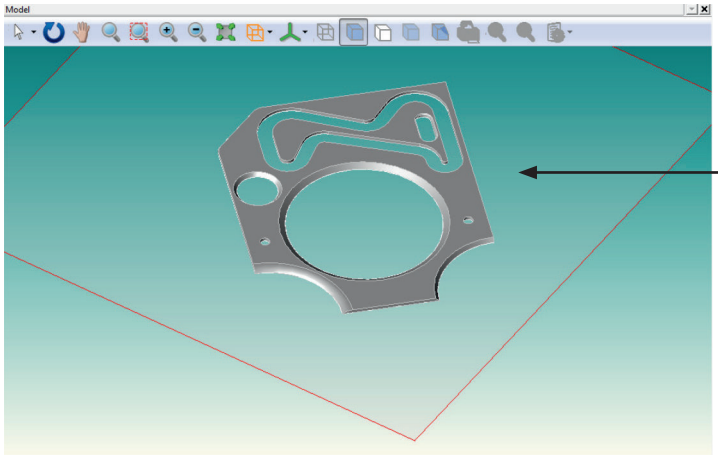




Alternatively, the position of the slice can be defined using the nominal data of the CAD model (rather than manually inputting the values for the slice plane centre).

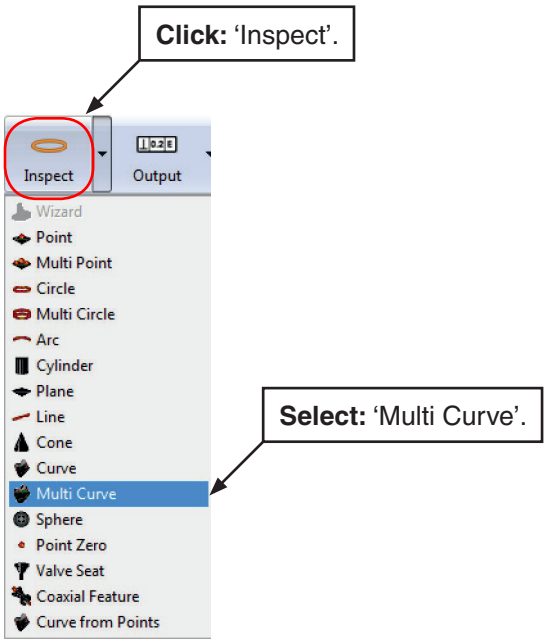
Start this second method in the same way as the first.

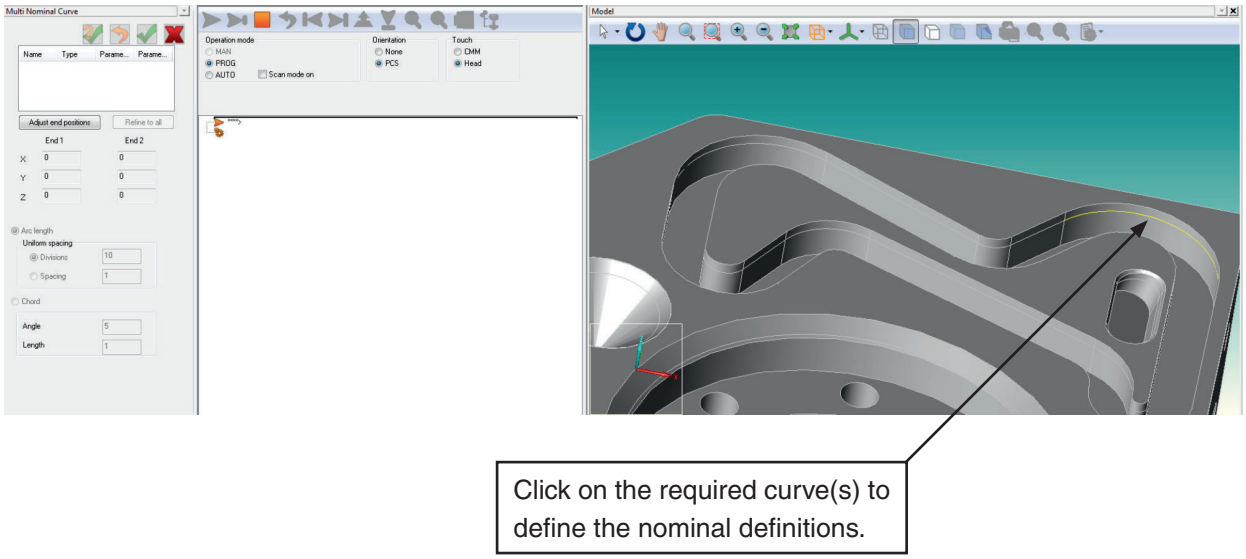




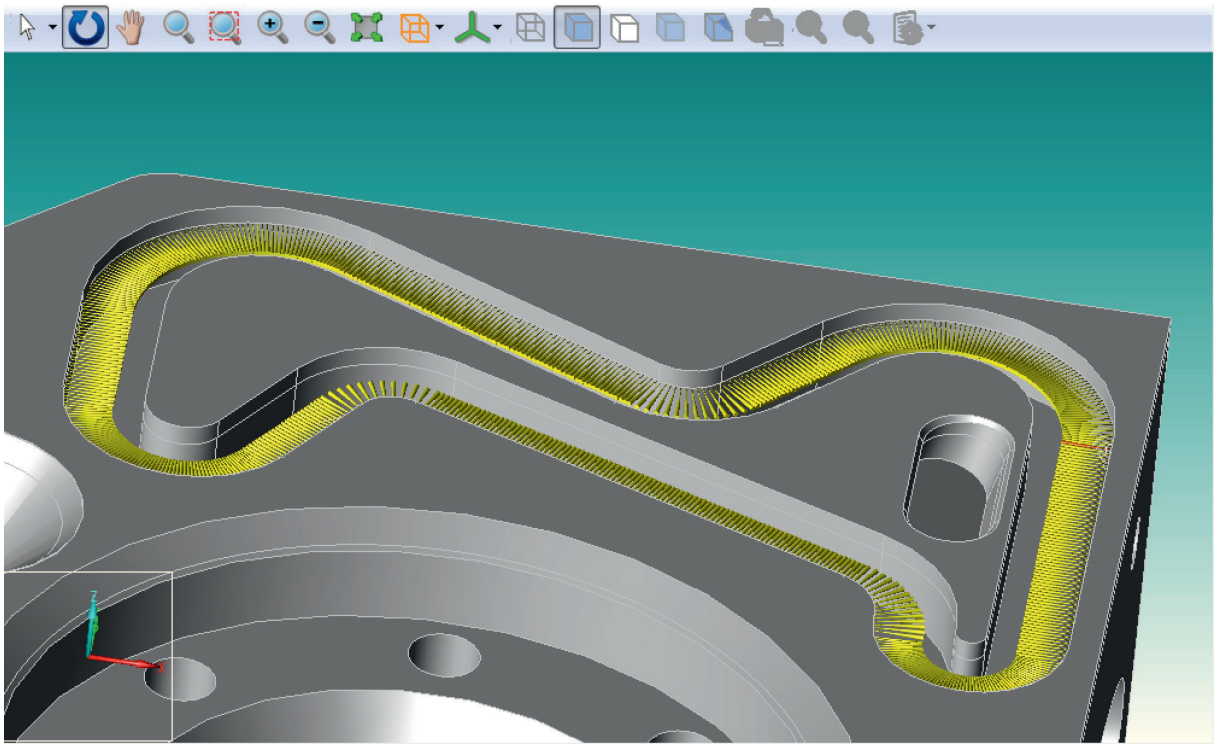
The model will now be displayed cut through the slice.

4 Create a multi curve on the model





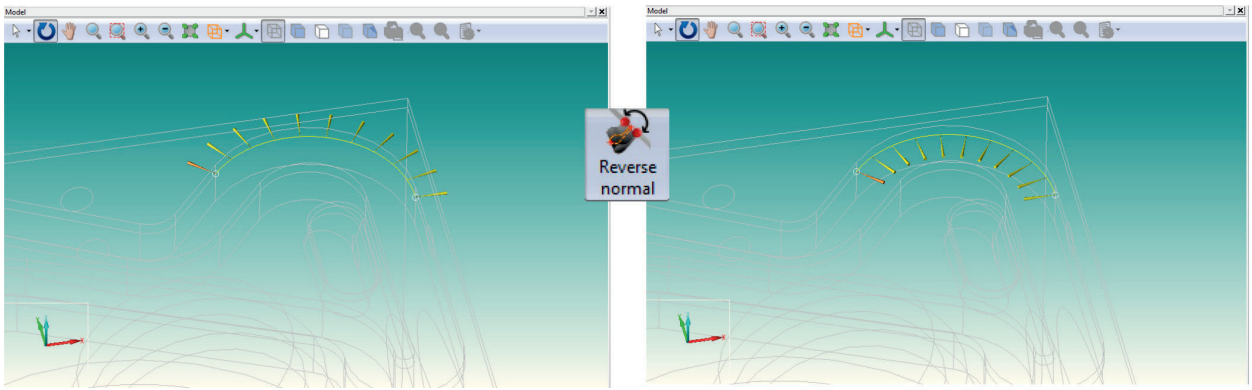
GUIDANCE NOTE: When measuring a closed curve it is possible to select all curves required at the same time. This is done by holding down the 'Ctrl' key and clicking on any curved section of the curves to be measured (this will not work if a straight section of a curve is selected).



The resultant curve is shown in the screen shot above. All other measurement techniques and settings required with this method will be the same as described previously. Due to the complex nature of curve scanning, different algorithms apply to different applications.

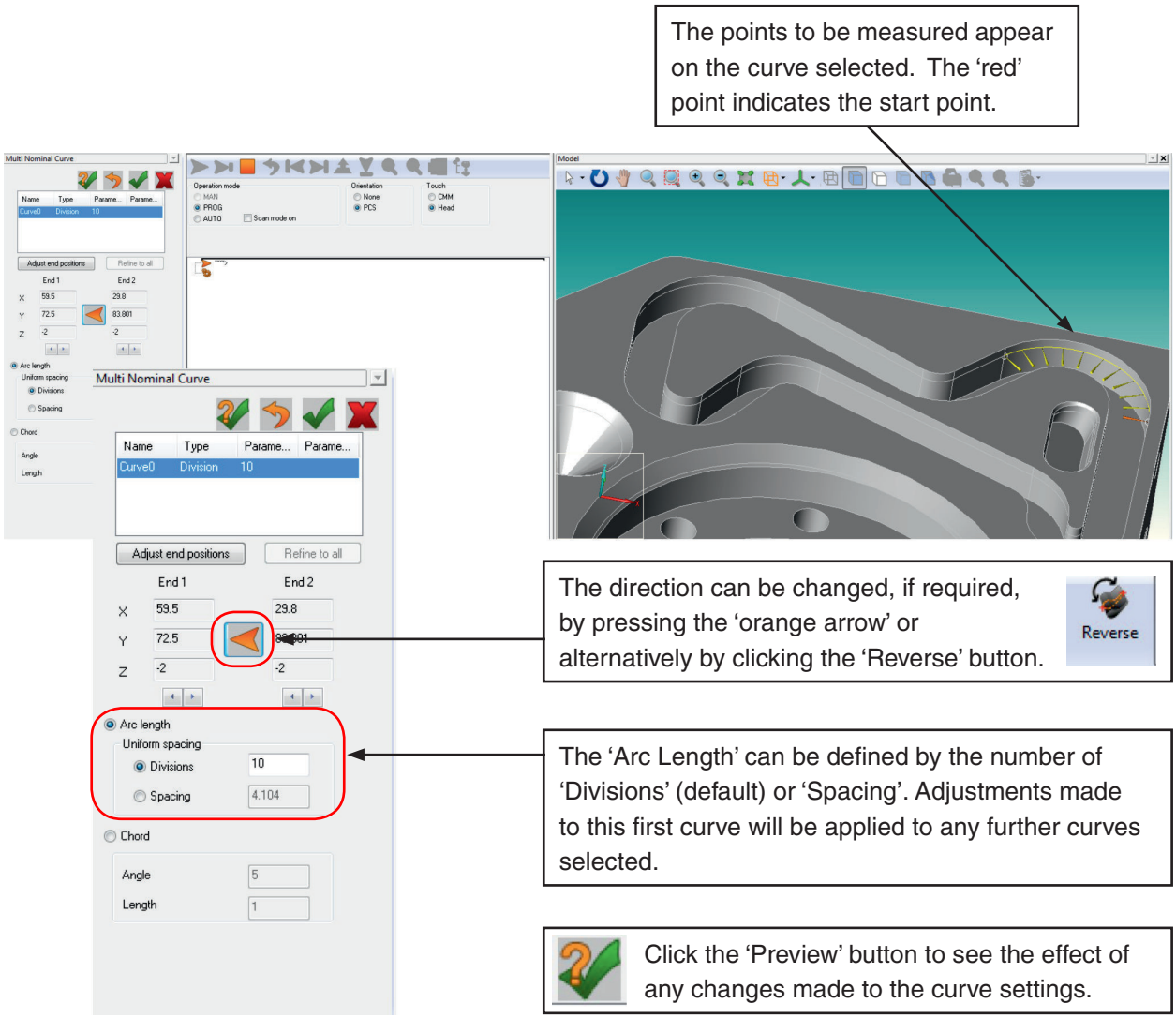
To see the various algorithms available click on 'Settings' then select 'Geometry algorithm'. Please refer to MODUS help (F1) for additional information.

Having now selected all the curves to be measured, any modifications can be made to the nominal data.



GUIDANCE NOTE: Changing the model view to 'Wire Frame' allows the yellow markers to be seen when they are within the material of the part.

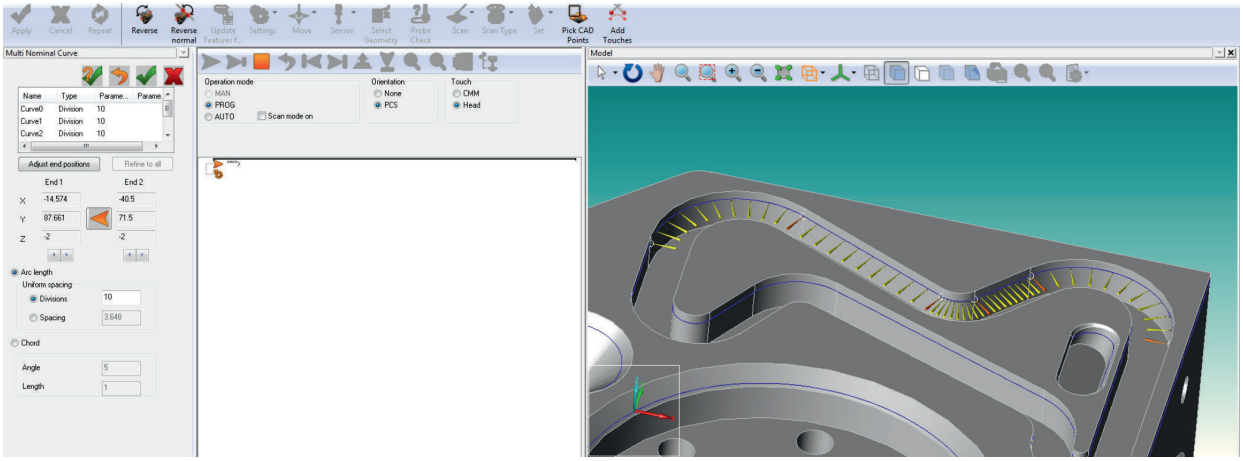
On some occasions, due to the CAD model construction, when clicking to select the curve the points vector will be reversed (as shown in the left screen shot above). This can be corrected by clicking on the 'Reverse Normal' button. The corrected curve is shown in the right screen shot above.



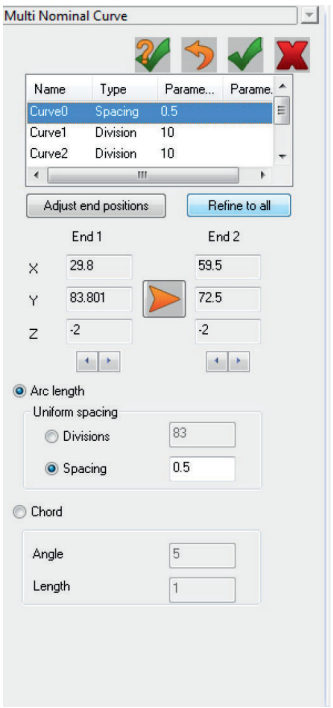
Further information on 'Chord' settings are given later in this tutorial or in MODUS help (F1).

Continue to select all the curves to be measured.

GUIDANCE NOTE: It is very important not to click the 'Adjust End Positions' button until all required curves have been selected. An explanation of this button will be given later.

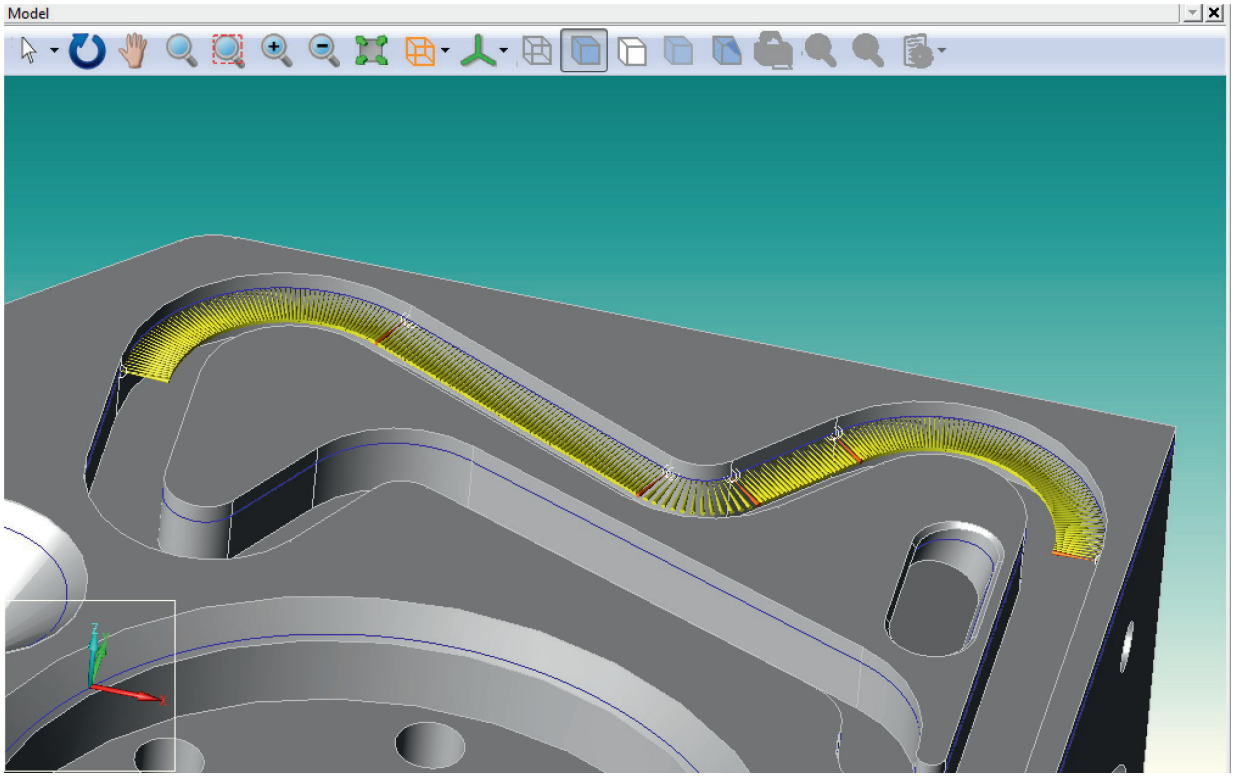


After selecting all the desired curves, modifications can be made to the default definitions.

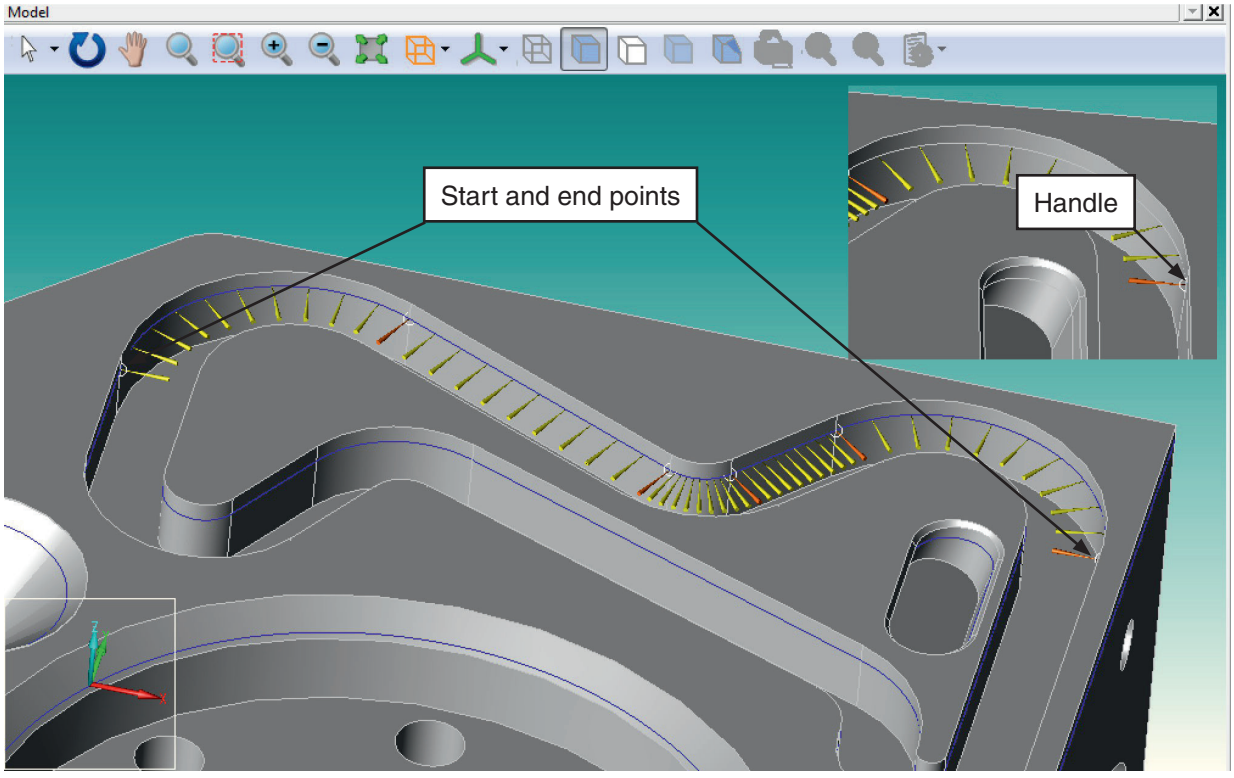


Highlight the first curve and change ‘Arc length’ from ‘Divisions’ to ‘Spacing’ and enter the desired point spacing. After clicking the ‘Preview’ button to update the changes the ‘Refine to all’ button becomes available. Clicking this then applies the modification to all of the curves. Alternatively, parameters can be modified individually for each curve.

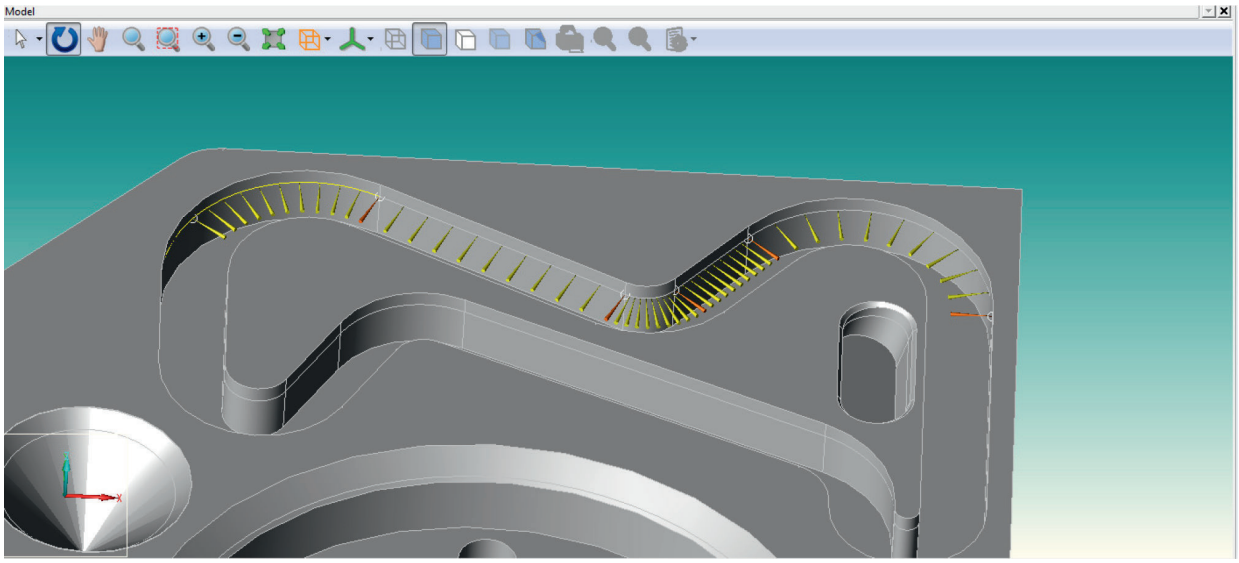
Further information on changes that can be made at this stage can be found in MODUS help (F1).

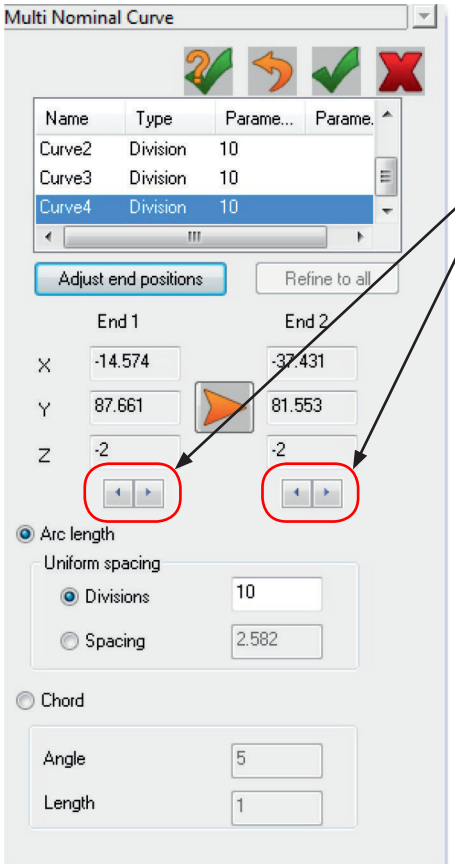


The start and end position of the curve measurement can also be modified.



To move the start and / or end point, highlight the curve to be changed, click on the ‘Adjust End Positions’ button and then ‘grab’ the ‘Handle’. To do this hold left mouse button down on the handle and drag the handle to the desired position. The example below shows a modified end position:





If preferred, for more accurate manipulation of the ‘Handles’ move the start or end of the curve using the ‘Arrow Keys’ located below the X,Y,Z ‘End’ boxes.

When using the ‘Arrow’ keys the value by which they move the ends of the curve can be varied as follows:

By clicking on the ‘Arrow’ keys, the ends move by 0.1 mm along the curve nominal

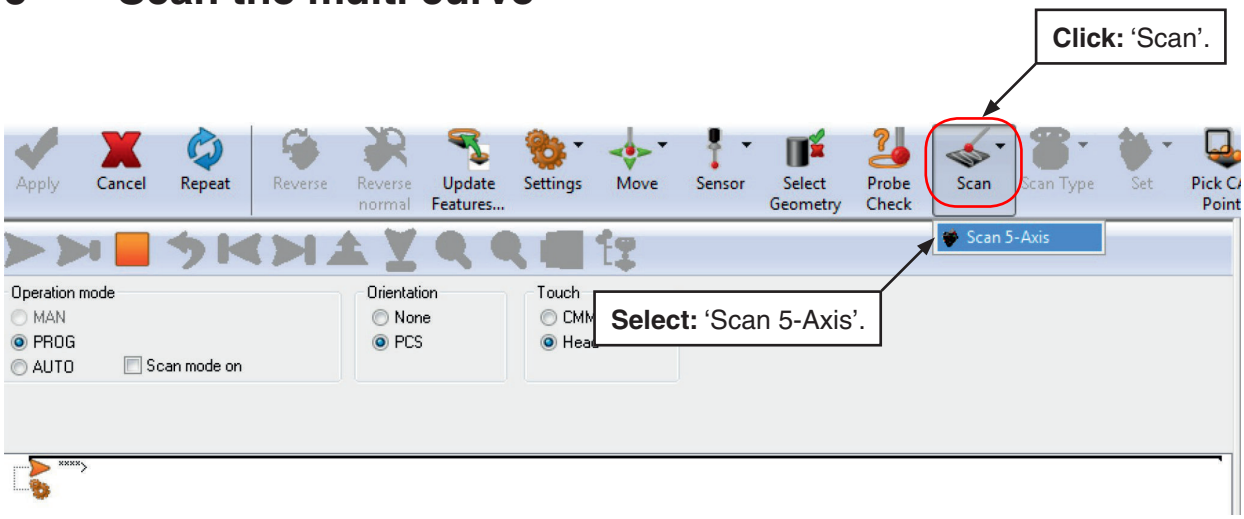
By holding down the left ‘Shift’ key and then clicking the ‘Arrow’ keys, the ends move by 0.01 mm along the curve nominal

By holding down the right ‘Shift’ key and then clicking the ‘Arrow’ keys, the ends move by 0.001 mm along the curve nominal

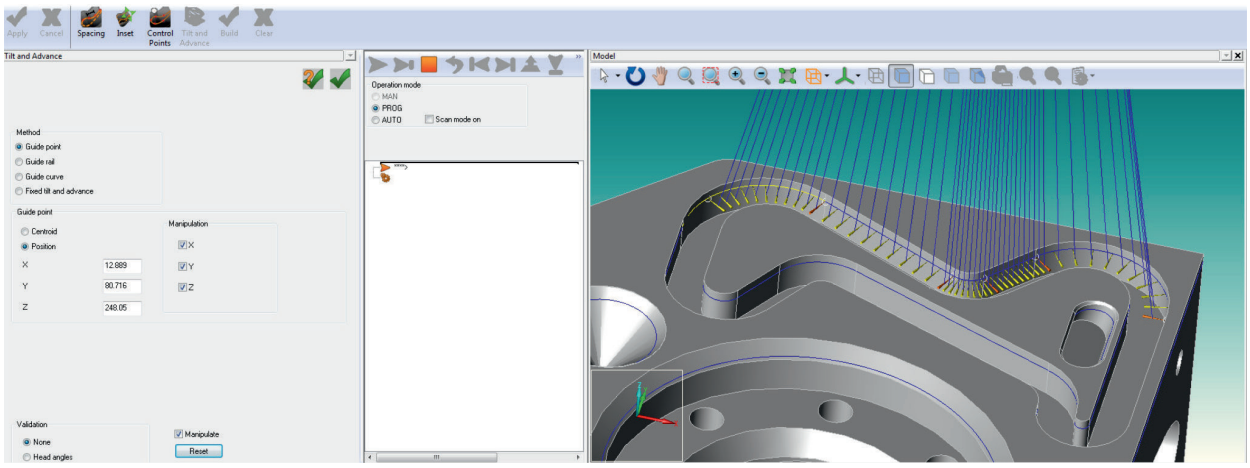
For further information refer to MODUS help (F1).

When all modifications and settings have been made to the selected curves click the ‘Green Tick’ to continue.

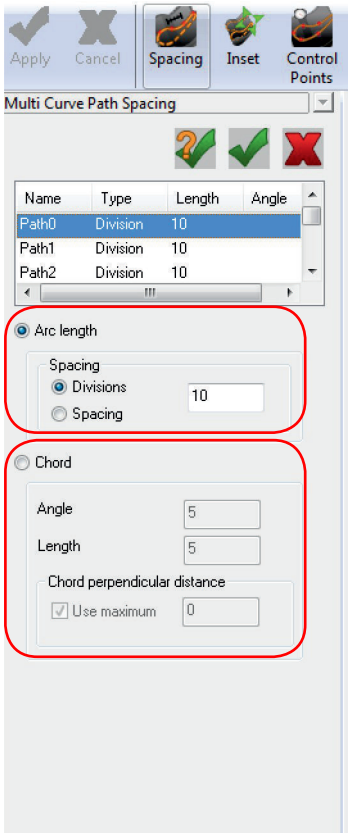
5 Scan the multi curve



The following screen will be now be displayed. Select and modify the preferred method of 'Tilt and Advance' from the options available. For information on using 'Tilt and Advance' see the 'Plane Scanning' tutorial.



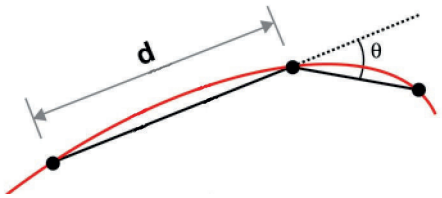
At this stage there is also the option to make changes to ‘Spacing’, ‘Inset’ and ‘Control Points’ as indicated in the following screen shots.

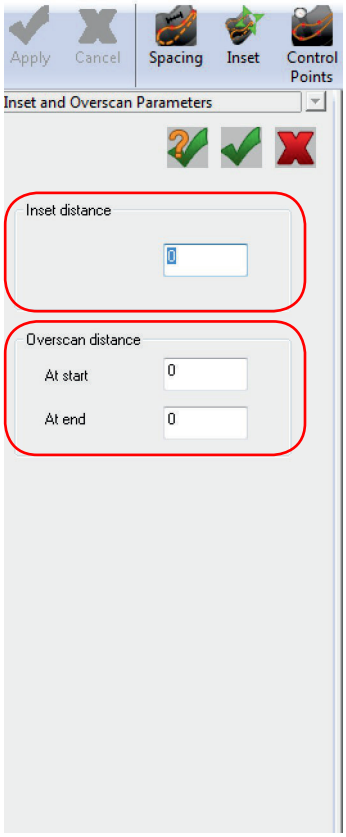


The ‘Spacing’ dialogue window defines the point settings for the scan path (for efficiency this can be different to the scan nominal) by either arc length or chord.

‘Arc length’ sets the point spacing by either the number of divisions defined over the length of the curve or by the spacing of the points over the length of the curve.

‘Chord’ sets the point spacing by defining the chord length (d) and angle (ᵉ).

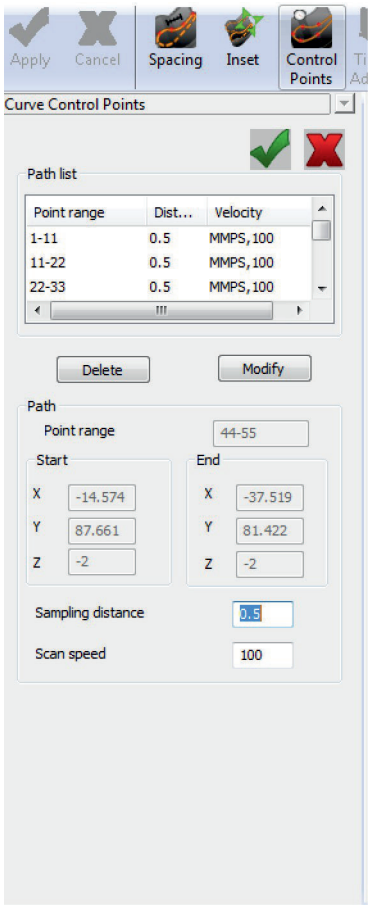




The ‘Inset’ and ‘Overscan’ dialogue window allows the length and position of the inspection path to be modified.

‘Inset distance’ - The positive or negative value to move the curve along the plane axis of the curve.

‘Overscan distance’ sets distances required for overscanning at the start and end of the curve. This can be useful to allow for the probe getting up to speed before it reaches the nominal curve, and slowing down after it has reached the end of the curve.

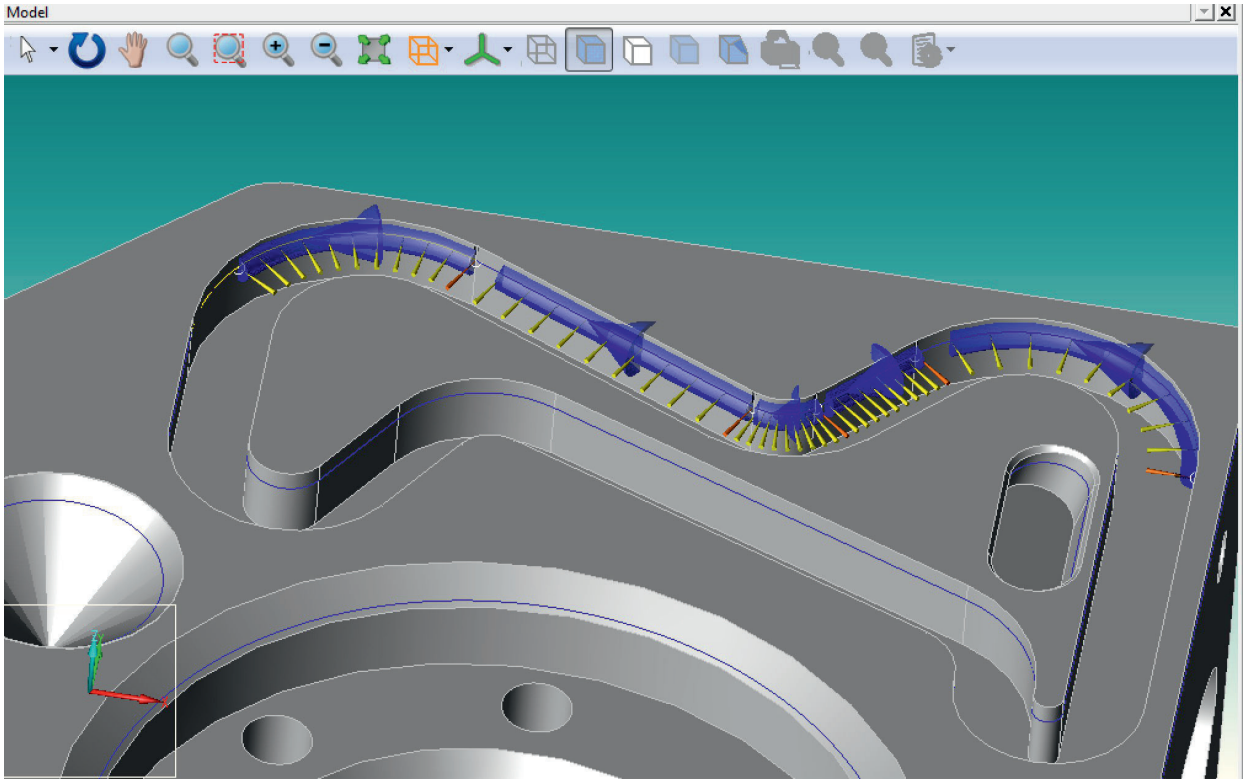


The 'Curve Control Points' dialogue window allows the sampling distance and scan speed for each portion of the curve to be modified.

GUIDANCE NOTE: When making changes to these settings the 'Modify' button must be clicked prior to clicking on the 'Green Tick'.

GUIDANCE NOTE: Further information on 'Spacing', 'Inset' and 'Control Points' can be obtained in MODUS help (F1).

When all settings have been made click the 'Green Tick' to continue. Next click the 'Build' button.



Click: 'Green Tick' twice and the curve will be scanned.

The following code will be produced in the program for this curve scan:

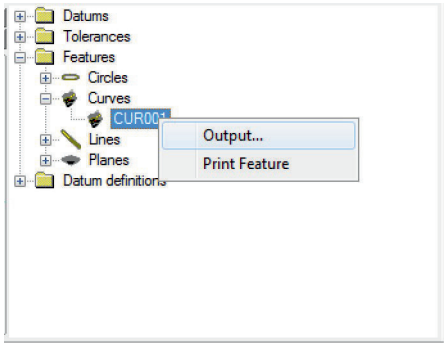
```
000202  P(PCrv8)=PATH/CURVE,PTDATA,59.5,72.5,-2,-1,0,0,PCS,169.313818,10.060638,-169.150866,PTDATA,59.006908,7
000203  P(PCrv9)=PATH/CURVE,PTDATA,29.800228,83.801141,-2,0.747045,-0.664773,0,PCS,-176.768121,4.383064,-44.98
000204  P(PCrv10)=PATH/CURVE,PTDATA,21.235227,74.176135,-2,0.747045,-0.664773,0,PCS,141.050149,3.111377,-2.719
000205  P(PCrv11)=PATH/CURVE,PTDATA,15.298379,73.010806,-2,-0.440324,-0.897839,0,PCS,95.877362,2.396299,-32.02
000206  P(PCrv12)=PATH/CURVE,PTDATA,-14.574165,87.6611,-2,-0.440324,-0.897839,0,PCS,-8.377246,6.640668,72.3643
000207  MODE/PROG,MAN
000208  F(CUR001)=FEAT/GCURVE,CART,12.202,80.058,-2,0,0,1,PTDATA,59.5,72.5,-2,-1,0,0,59.007,76.565,-2,-0.971,-
000209  MEAS/GCURVE,F(CUR001),2
000210  PAMEAS/DISTANCE,2.17,SCNVEL,MMPS,0.4,P(PCrv8),-1,0,0,DISTANCE,2.17,SCNVEL,MMPS,0.4,P(PCrv9),0,0,1,DIST
000211  $$</>
000212  ENDMES
```

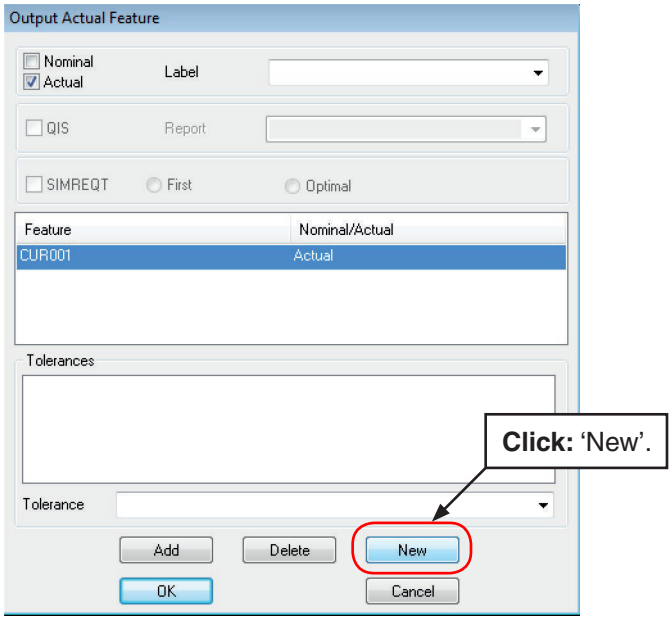
Now that the curve has been measured, tolerances can be applied to it. This will enable a report to be produced showing its profile.

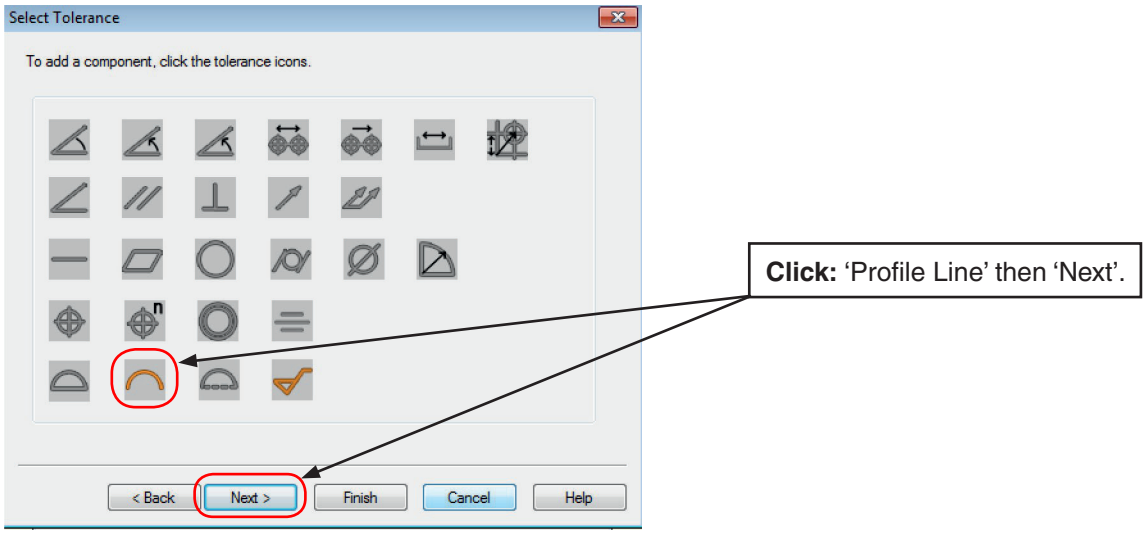
6 Tolerance and output the measured data

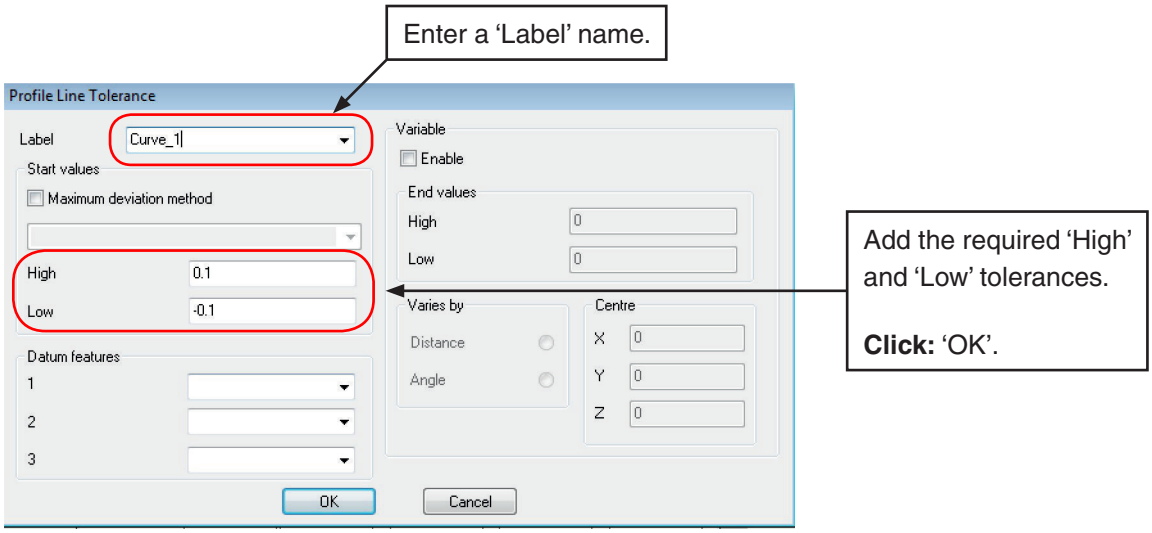
In the ‘Explorer’ box, double left mouse click on ‘Features’ then double left mouse click on ‘Curves’.

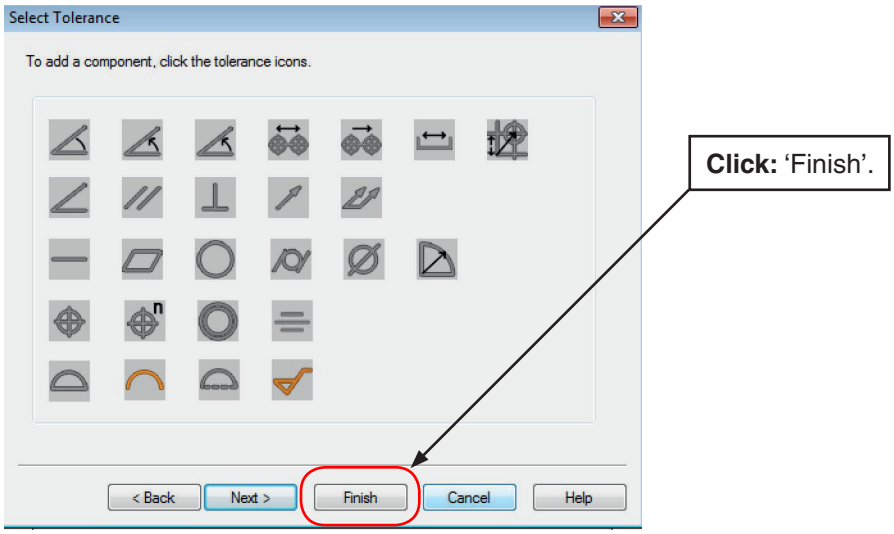
Right mouse click on the required curve, then left mouse click on ‘Output’. The following dialogue box will be displayed:

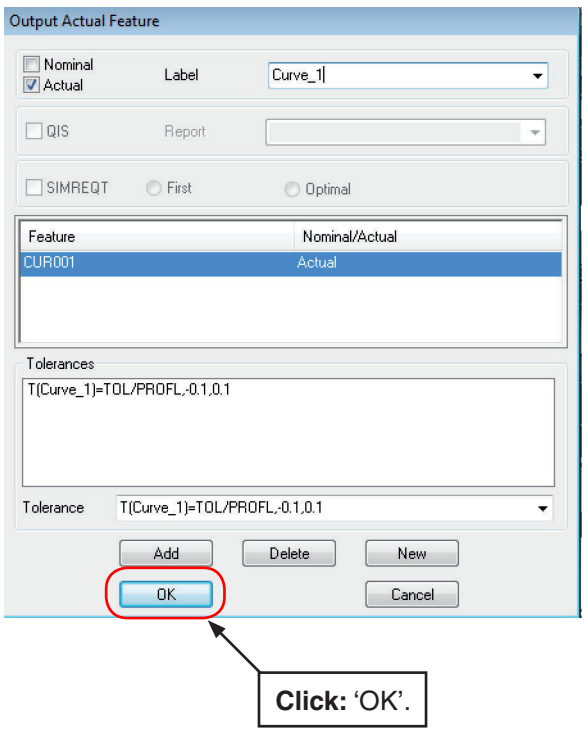







Enter a ‘Label’ name.
Profile Line Tolerance
Label
Curve_1
Start values
Maximum deviation method
High
0.1
Low
-0.1
Datum features
1
2
3
Variable
Enable
End values
High
0
Low
0
Varies by
Distance
Angle
Centre
X
0
Y
0
Z
0
OK
Cancel
Add the required ‘High’ and ‘Low’ tolerances.
Click: ‘OK’.


Select Tolerance
To add a component, click the tolerance icons.
< Back
Next >
Finish
Cancel
Help
Click: ‘Finish’.

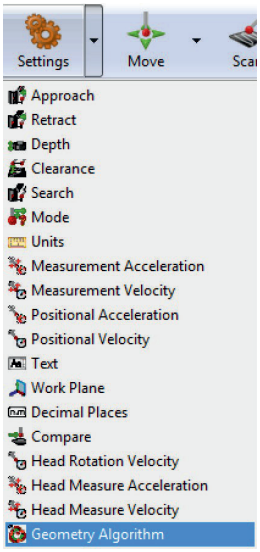

Output Actual Feature
Nominal
Actual
Label
Curve_1
QIS
Report
SIMREQT
First
Optimal
Feature
Nominal/Actual
CUR001
Actual
Tolerances
T(Curve_1)=TOL/PROFL,-0.1,0.1
Tolerance
T(Curve_1)=TOL/PROFL,-0.1,0.1
Add
Delete
New
OK
Cancel
Click: ‘OK’.

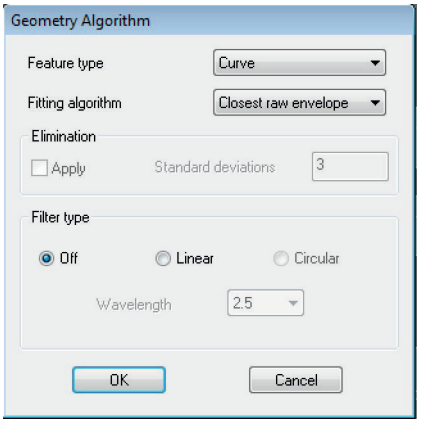
Following completion of this output, results will be displayed in the ‘Output’ box and the following code in the part program:

```
000216  T(Curve_1)=TOL/PROFL,-0.1,0.1
000217  OUTPUT/FA(CUR001),TA(Curve_1)
000218
```

GUIDANCE NOTE: Due to the complex nature of curve scanning, different algorithms apply to different applications.

To see the various algorithms available click on ‘Settings’ then select ‘Geometry algorithm’. Please refer to MODUS help (F1) for additional information.





This page intentionally left blank

Renishaw plc

New Mills, Wotton-under-Edge,
Gloucestershire, GL12 8JR
United Kingdom

T +44 (0)1453 524524
F +44 (0)1453 524901
E uk@renishaw.com

www.renishaw.com

RENISHAW
apply innovation™

For worldwide contact details, please visit our main web site at www.renishaw.com/contact

H-1000-5308-01